

The 'uranium province' prepares for development

When the explorer Ludwig Leichhardt crossed Arnhem Land in 1845 on his way to Port Essington from Brisbane, he noted that buffaloes were numerous in the Alligator Rivers region. There were three short-lived British settlements on the north coast in the 1820s, '30s, and '40s; their lasting memorials—for the following century virtually the only contributions of the white man to the natural environment of the region—are the buffalo, the wild pig, and the cattle tick.

Buffaloes have thrived and multiplied, and their wallowing has done considerable damage to rainforest and flood-plain habitats. Now uranium has been found, worth more than a thousand million dollars, and much more probably remains to be discovered. People, mining, and money seem poised to move in in strength, and the potential impact on the environment is immense. Archaeological evidence shows us that Aborigines have lived in the region, in harmony with their surroundings, for at least 25 000 years. Great damage, much of it irreversible, could be done now in a few years.

Fortunately the threat, and the importance of maintaining the remarkable natural features of the area, have come to be widely recognized. In 1964 the Woolwonga Wildlife Reserve was established east of the South Alligator River, and a much larger adjoining area of 3250 sq km was declared a wildlife sanctuary in 1972. In 1971 two areas totalling 333 sq km were declared reserves from mining. In 1965 the Northern Territory Reserves Board proposed the establishment of a national park of about 5180 sq km in the Alligator Rivers region, and in December

last year the Prime Minister announced the Government's intention to establish a national park there called Kakadu. It will cover about 3750 sq km immediately west of the Arnhem Land Aboriginal Reserve.

Two years ago, in May 1972, the Government and the mining industry agreed to jointly sponsor a wide-ranging scientific study of the area. The Department of the Northern Territory and the Australian Mining Industry Council have now distributed a review report of the study, which forms the basis of this article.

The Alligator Rivers region, 19 000 sq km in all, comprises all the catchments of the East Alligator River and Cooper's Creek and the eastern catchments of the South Alligator River. In the south and east lies a rugged, largely untrafficable plateau. Its steep edges form the spectacular Arnhem Land escarpment that rises 50–250 m above the undulating plains of the lowlands. Streams dividing these plains lead either to one or other of the Alligator Rivers or to extensive flood-plain areas between them. The flood-plains, which are inundated annually by fresh water, begin where the stream systems leave the lowland country and extend east

and west to the Alligator Rivers, along the rivers in wide bands, and north to the tidal flats of the river estuaries.

The year is made up of the 'wet', from November to March, and the 'dry', from May to September, with April and October as transitional months. Rainfall is reliable and averages about 1340 mm a year. Virtually no rain falls in the dry.

Richest fauna

What is so special about the place? Let's start with the fauna. According to the study team from the CSIRO Division of Wildlife Research, it is the richest in the Northern Territory and is matched in Australia only in parts of north-eastern Queensland. About 51 species of native mammals, at least 230 of birds, 75 of reptiles, and 22 of frogs are known. Many are of great scientific interest, including an extremely rare frog, the sandstone friar-bird, some very rare reptiles, and a primitive mammal, the false water-rat, also very rare. A few are restricted to the region, others are found in greatest numbers there although they occur in adjacent areas, and some are rare although found elsewhere.

The team from the CSIRO Division of Entomology recognized about 4500 species of insects, and up to 50% in some groups are new to science. Some appear to be relics of a once more-widespread fauna and others are of special interest for other reasons. Further collections are expected to reveal as many species again.

The flora also is rich. The study recorded 954 species, some previously not known. Among the plant groups are scarce relic communities of dense, evergreen, non-eucalypt rainforest and of semi-deciduous forest—survivors from another age and climate.

Scenically the region is greatly endowed; it offers much for the tourist to see and do. It has the escarpment with its sheer cliffs, interesting formations, varied colouring, and magnificent views from the top. Valleys and gorges contain waterfalls, rapids, springs, patches of lush vegetation,



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wildlife, and pools. There are spots where barramundi can be fished, swimming sites, and excellent areas for watching wildlife, especially birds. Also Aboriginal art abounds.

Economically, prospects are good for pasture improvement in the lowlands and flood-plains and for much-increased meat production—both from buffaloes subjec-

ted to controlled management and from improved beef cattle. The Animal Industry Branch of the Department of the Northern Territory estimates that, if all suitable lands were developed for this purpose, the region could carry about 130 000 head compared with the present wild buffalo population and a cattle population of between 2000 and 3000. Tourism also has potential. The Department of the Northern Territory estimates current use at 19 000 visitor-days per year and believes this could increase substantially if facilities were improved. Overshadowing these prospects in economic terms is the uranium potential.

The possible environmental threats to the region are many and varied. The most obvious are probably those associated with uranium-mining and uncontrolled tourism.

Uranium-mining

Exploration licences cover almost the entire region, and the general conclusion from investigations to date is that all areas have potential for uranium discoveries and the region as a whole has great potential for further discoveries. Major activity has so far been concentrated at the four lowland locations where promising deposits have been found; access roads and mine camps have been built, and testing and investigatory drilling has been carried out. The report says that, so far as is known, current developments are not disturbing any sensitive features.

If mining goes ahead it will create, apart from the inevitable disturbance to the immediate environment, the threat of wastes, if they are not contained, being washed away and causing disturbances

Aims of the study and the groups involved

The Alligator Rivers Region Environmental Fact-finding Study, whose review report forms the basis of the accompanying article, was a cooperative project sponsored and financed jointly by the Australian Government and mining interests. Discussions between representatives of a number of Government Departments and mining companies with interests in the area culminated in an agreement in May 1972 to proceed with a study, which was to be completed by the end of 1973.

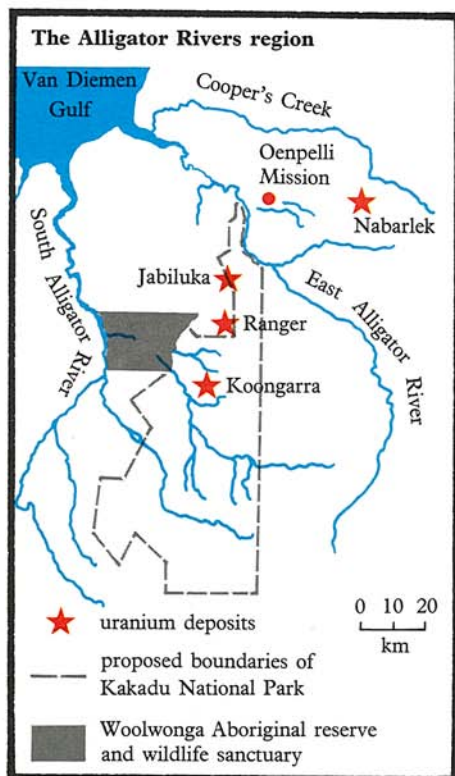
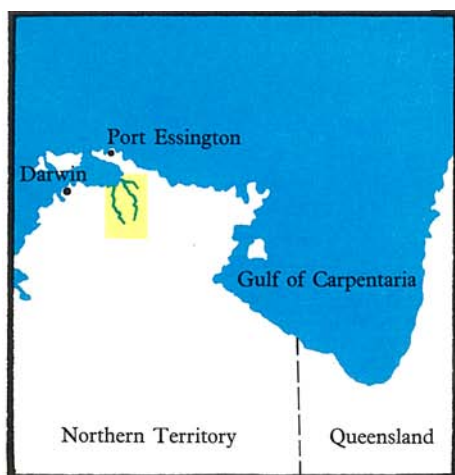
The Study was divided into 12 projects, each of which resulted in one report or more. The projects and the groups involved were:

- ▶ Land evaluation survey—CSIRO Division of Land Use Research, Department of the Northern Territory, and Macquarie University
- ▶ Entomological survey—CSIRO Division of Entomology
- ▶ Wildlife survey—CSIRO Division of Wildlife Research
- ▶ Freshwater fish survey—consultant Mr Hamer Midgley, in association with the Department of the Northern Territory
- ▶ Climate—CSIRO Division of Land Use Research
- ▶ Water quality—Australian Atomic Energy Commission and Department of the Northern Territory
- ▶ Hydrology (water sampling and stream gauging)—Department of the Northern Territory
- ▶ Landscape and recreation and forestry resource inventory—Department of the Northern Territory
- ▶ Geology—Bureau of Mineral Resources and exploration companies
- ▶ Archaeology survey and site identifica-

tion—consultants Mr Johan Kamminga and Dr Harry Allen

- ▶ Aboriginal art location, identification, and classification — consultant Mr Robert Edwards
- ▶ Atmospheric conditions—Ranger Uranium Mines Pty Ltd

The survey report points out that its task was not 'to make judgments between economic, cultural, or aesthetic values'. It says: 'The study committee considers that the information obtained by the Environmental Fact-finding Study is adequate for general regional environmental assessments and land use policy making. In terms of government policy, each significant project involving the use of land, be it tourism, mining, pastoral development, conservation, town site or highway construction, or power distribution, will need to be the subject of detailed environmental studies.'



Looking north along the Arnhem Land escarpment.

Uranium

Present stated reserves of uranium oxide in the Alligator Rivers region exceed 90 000 tonnes. They have a gross value, at present world market prices, of about \$1500 million.

Exploration to date has been based mainly on follow-up of anomalies detected by airborne surveys. These, and ground radiometric surveys, can usually only detect radiation from about the top metre of soil or rock, and most of the anomalies discovered have been in areas adjacent to the escarpment, where sand and soil cover is generally thin. Exploration licences cover almost the whole region, and mining authorities regard all

areas as having potential. They consider that much larger quantities are probably yet to be found.

The four major discoveries, and their stated reserves at the time the report was written, are:

- Nabarlek, about 270 km east of Darwin in the Arnhem Land Aboriginal Reserve, held by Queensland Mines Ltd, stated reserves 9400 tonnes of U_3O_8 in exceptionally high-grade ore
- Ranger, about 65 km south-west of Nabarlek, held by a joint venture of Peko Mines N. L. and Electrolytic Zinc Co. of Australasia Ltd, stated reserves about 80 000 tonnes U_3O_8 (possible reserves could boost this figure)
- Koongarra, about 24 km south-south-west of Ranger in Wildlife Sanctuary, held by Noranda Australia Ltd; the company has not issued any assessment of reserves, but considers the deposit viable
- Jabiluka, about 24 km north of Ranger, held by Pancontinental Mining Ltd, stated reserves about 3400 tonnes U_3O_8 ; drilling 500 m to the east has encountered a new large deposit

elsewhere. The Australian Atomic Energy Commission and the Department of the Northern Territory studied the capacity of the drainage system to flush these away harmlessly and found it very limited. Much of the drainage from the uranium deposit areas is by creek systems that lead to flood-plains, and it is believed that, in years of low rainfall, little if any of their water reaches the rivers and the sea.

Some time after the end of the wet, most streams in these systems cease to flow except in the upper reaches; downstream, water remains in a string of billabongs. Towards the end of the dry the natural uranium content of this water rises, possibly by 10 to 100 times, its radium content may rise, although less sharply, turbidity increases, and levels of zinc, manganese, and iron increase. Water temperature rises, with a consequent loss of dissolved oxygen. Some fish die.

The report concludes that, judging from the available data, the drainage system has only a very small capacity to absorb without damage increased quantities of elements, such as zinc, copper, and manganese, that may occur in uncontrollable run-off from mining operations. It also points to the danger of allowing a long-

term build-up of contaminants on the flood-plains, which act as 'sinks' for dissolved and suspended material carried to them in the wet. Limits would have to be imposed on discharges, it says, and these would need to be examined in detail for specific development proposals.

A team of researchers tested radium levels occurring naturally in foods produced in the region. Setting a deliberately high dietary intake for someone dependent on locally produced foods, they arrived at an annual intake of 8.5 nCi (nanocuries). This natural background

level is 16 times as high as that for an average inhabitant of Britain or Italy, where similar measurements have been made, and approximates the limit of exposure above background levels for radium, 8 nCi, recommended by the International Commission for Radiological Protection.

The report indicates that controls would need to be exercised both on total amounts of radioactive elements released from uranium mining and processing operations and on concentrations at discharge. The level of radium in water of the drainage systems would be the main determinant; it would influence the levels in all foods produced downstream as well as in drinking water. Sufficient information is available to formulate conservative discharge authorizations for all known economic uranium deposits when production plans become available, the report says. It lists the potential wastes from uranium-mining and methods that are available for controlling them.

People bring problems

Development of an area requires people, who require somewhere to live, and construction of a regional township for 15 000



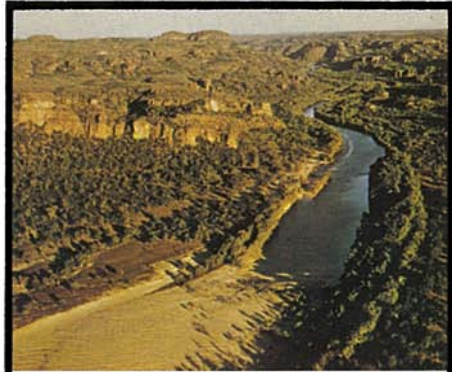
A wildlife survey party in lowland grasslands.



A grass fire beside Magela Creek; the creek flows into flood-plains between the Alligator Rivers.



A rare Fly River turtle pictured by an Aboriginal artist.



The East Alligator River.



Buffaloes.



A Wildlife Research group at work near Mt Brockman in escarpment country. Left to right: Mr Ian Mason, Mr Tony Wolfe, and Mr John Calaby.

people is being considered. Such a town could need a water supply. While the escarpment area contains two sites suitable for dams, significant Aboriginal sites could suffer interference if they were built, and interruption of dry-season flows could have severe consequences for biological habitats downstream. The study team from the Department of the Northern Territory concluded that it would be better to supply the town from groundwater sources that are available.

Maintenance of water flow to the floodplains is vital, not only for water-dwelling fauna but also for the large numbers of aquatic birds of many species for which the swamps and billabongs of the floodplains provide habitats and dry-season refuges. A reduction in the depth of flooding or in the length of time during which flow continues on to the plains in the dry season could adversely affect wildlife because of reduction in water quality as well as in the amount of water available.

The attractions for tourists are many, and perhaps the greatest danger to the tourist resource would be large increases in numbers of uncontrolled visitors. Careful management is needed. Aboriginal art and archeological sites require protection. Upstream rock pools, billabongs, and

spring-fed creeks surrounded by lush shady vegetation are attractive recreation spots, vulnerable to damage from people in large numbers and from uncontrolled vehicle use. Forest and scrub communities along the escarpment—alive with wildlife, particularly birds—are numerous but small, so while the types should be safe they are vulnerable individually.

The relic coastal rainforest and semi-deciduous forest communities, interesting for their plant and animal life and their antiquity, could be further damaged if they became popular recreation sites. Buffaloes and recurring fires are already causing them to retreat more quickly than they could be expected to naturally because of their marginal adaptation. A program is in progress in the wildlife sanctuaries to eliminate buffaloes, which are most concentrated on the floodplains, the nearby lowlands, and the lowland drainage lines. So far the domestic cat has not become common in the wild; if it did, many small animals would be threatened.

Two-way threat

An influx of people to the region poses clear threats to the environment. On the other hand the environment also poses threats to people; a number of health risks

should be guarded against. However, these are shared with other areas of northern Australia, and effective methods of protection are available. The region is receptive to malaria; it already contains three potential mosquito vectors of the disease. According to the report, malaria is the biggest public health risk. Migratory water birds, widespread in the region, harbour reservoirs of Japanese B encephalitis and Murray Valley encephalitis viruses, and mosquitoes could also spread these and other arbovirus diseases, including haemorrhagic fever and the dengue group. Other disease risks include hookworm, which is prevalent in the Aboriginal population.

The study has gathered and brought together an enormous amount of information that will help people planning the area's future to take knowledgeable account of environmental factors. The future character of the region is very much in their hands.

More about the topic

'A Review Report of the Alligator Rivers Region Environmental Fact-finding Study.' (The Department of the Northern Territory and the Australian Mining Industry Council: Darwin 1974.)

Archaeology, art, and sacred sites

When the Aborigines came to Australia they probably entered via the north. Some found the Alligator Rivers region hospitable—as now, it was richly endowed environmentally—and records of their occupation have been found dating back 25 000 years.

The Study recorded more than 120 archaeological sites, most of them on the plateau outliers to the west and north of the main escarpment. These have yielded the world's oldest evidence for the technology of grinding stone for axes and the oldest grindstones in Australia. Material is very well preserved at some sites, and opens up the prospect of gaining knowledge of the way of life of people in the area in the Pleistocene epoch, which ended about 11 000 years ago, and up to the present.

Some important sites have been damaged by animals or people, and the report says accessible and transportable relics will be in increasing danger if more people come to the region unless further protective measures are taken. Sites near mining company activities have been protec-

ted by strict instructions to staff and the appointment of additional rangers.

Aboriginal rock art also is present in abundance and fine quality. Charles Mountford, an authority in the field, has described one group of cave paintings as the most numerous and beautiful series known in Australia. More than 300 sites were recorded in the Study, and the descriptions and photographic coverage are the most extensive available.

The paintings of animals have produced surprises. One is said to undoubtedly represent the Tasmanian tiger, a species not known from live specimens or as fossils in northern Australia. Another depicts a relic species, the Fly River turtle of Papua-New Guinea; one of these turtles was found in the Daly River area in 1969 and one in the Alligator Rivers region during the Study.

The paintings will not last unless special efforts are made to protect them. The need for permanence in the original pigments did not concern the artists, as regular retouching of paintings of significance was a tribal law and responsibility.

No noticeable deterioration of rock art took place until Aborigines made contact with Europeans and their traditional cultures began to collapse. Lack of retouching, the natural processes of weathering, water erosion, seepage, tree growth in fissures, wasps nests on painting surfaces, termite clay trails, and feral animals rubbing against the paintings are taking their toll.

Inaccessibility has minimized vandalism, but experience elsewhere suggests that, as numbers of visitors increase, writing or carving of names and other forms of damage could become serious unless adequate protective measures are adopted.

About 660 Aborigines live in the region now, most of them at Oenpelli mission. The report points out that many landscape features and locations have or did have considerable significance of a sacred or mythological nature to living Aborigines and that these should be regarded with respect. It says that, to protect sites of significance, advice is needed from the Aborigines whose traditional rights may be concerned with specific areas.